Sleep Medicine 15 (2014) 196–202

Contents lists available at ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Original Article

Validation of the Japanese version of the Ford Insomnia Response to Stress Test and the association of sleep reactivity with trait anxiety and insomnia

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ARTICLE INFO

Article history:
Received 18 April 2013
Received in revised form 25 July 2013
Accepted 7 September 2013
Available online 2 December 2013

Keywords:
Insomnia
Sleep reactivity
Ford insomnia response to stress test
Stress
Anxiety
Scale

ABSTRACT

Objective: Our study was conducted to validate the Japanese version of the Ford Insomnia Response to Stress Test (FIRST-J) and to clarify the association of the measure with trait anxiety and insomnia in healthy subjects and insomnia patients.
Methods: We studied 161 healthy subjects and 177 insomnia patients who completed the FIRST-J, Pittsburgh Sleep Quality Index (PSQI), Athens Insomnia Scale (AIS), and State-Trait Anxiety Inventory-Trait (STAI). The healthy subjects and the insomnia patients were classified, respectively, into two groups with high FIRST-J and low FIRST-J scores (divided by the median value of healthy subjects).
Results: Cronbach α coefficients of the FIRST-J in the insomnia patients and healthy subjects were 0.89 and 0.87, respectively. Factor analysis revealed that the FIRST-J had a single-factor structure. The FIRST-J score significantly correlated with all other measures in the healthy subjects, though the score only correlated with the score of the STAI in the insomnia patients. The healthy subjects with high FIRST-J scores showed higher scores of the AIS and STAI than those with low FIRST-J scores. Furthermore, insomnia patients had a higher total score of the FIRST-J than the healthy subjects.
Conclusions: The FIRST-J is an important tool for assessing vulnerability to insomnia.

1. Introduction

Insomnia is characterized by difficulty initiating or maintaining sleep, with consequent impairment of daytime functioning. Previous epidemiologic studies have estimated the prevalence of insomnia as approximately 20% of general population in industrialized countries [1–3]. Insomnia also is known to be highly associated with increased risk for depression [4–8] and physical diseases such as cardiovascular disease [9,10] and type 2 diabetes mellitus [11,12], possibly engendering deterioration of health-related quality of life [13–16]. Therefore, it is desirable to identify vulnerability to development of the disorder.

The Ford Insomnia Response to Stress Test (FIRST), a self-administered questionnaire that assesses stress-induced sleep reactivity, provides an indicator of vulnerability to the development of insomnia [17]. The questionnaire includes nine items relevant to situational sleep-disturbing stimuli with a 4-point Likert scale (1, not likely; 4, very likely) [18]. Its total score ranges from 9 to 36. A higher score indicates a higher level of sleep reactivity to the stimuli. The nine items in the original English version of the FIRST were determined based on a consensus agreement of four experts in the field of insomnia research and results of factor analysis of the general population [18]. The questionnaire reportedly has a single-factor structure. Individuals with a higher score on the original version of the FIRST (>20, median score in general population sample) have lower sleep efficiency, longer sleep-onset latency (SOL), and increased percentage of stage 1 sleep on nocturnal polysomnogram (n-PSG) [18]. The reliability of the original version of the FIRST was confirmed by study results showing a Cronbach α coefficient of 0.83 and a test–retest reliability coefficient (r) of 0.92 [18].

Individuals with a higher FIRST score showed a greater number of awakenings on sleep logs and longer SOL on multiple sleep

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http://dx.doi.org/10.1016/j.sleep.2013.09.022

latency test [18]. Furthermore, Drake et al. [19] reported that individuals with high FIRST scores (>18, median score of the FIRST of the participants of the study) were likely to show longer SOL on n-PSG after ingestion of caffeine than those with low FIRST scores. Recently, the FIRST has been regarded as having an important genetic and environmental basis [20]. In addition, high FIRST scoring individuals reportedly showed a greater number of arousals and stage transitions and a decreased proportion of rapid eye movement sleep on n-PSG than those with low FIRST scoring individuals under high stress conditions [21].

The results presented above imply that the FIRST can predict the future development of insomnia caused by sleep reactivity related to hyperarousal. Trait anxiety is an important predisposing factor for the development of insomnia [22–26], which implies that trait anxiety contributes to increased sleep reactivity to situational sleep-disrupting stimuli. No validated measure other than the FIRST is available to assess the vulnerability to insomnia caused by stress-induced hyperarousal. Jefferson et al. [27] reported that insomnia patients had a higher FIRST score than healthy participants. However, no report in the relevant literature has confirmed if the FIRST is related to subjective severity of insomnia. Moreover, no Japanese version of the FIRST has been established to date.

The aims of our study were to validate the Japanese version of the FIRST (FIRST-J), to ascertain the association between sleep reactivity and trait anxiety, and to clarify the relation between subjective severity of insomnia and sleep reactivity manifested on the FIRST-J.

2. Methods

2.1. Participants and settings

The Regional Ethical Review Board of the Neuropsychiatric Research Institute in Japan approved our study protocol. After explaining the purpose and the method of our study to all participants, the participants provided written informed consent. Thereafter, the participants were asked to respond to the research questionnaires. Eligible participants were 513 consecutive patients who visited the outpatient clinic of the Japan Somnology Center seeking treatment for insomnia from October 2008 to February 2011 and 310 healthy participants engaged in regular daytime work (Fig. 1).

Patients with insomnia diagnosed by at least two sleep disorders specialist psychiatrists were enrolled in our study if they were age 20 years or older and met criteria for the diagnosis of psychophysiologic insomnia according to the second edition of the [28]. Patients were excluded from our study if they were diagnosed as having sleep disorders other than insomnia or as having insomnia secondary to psychiatric disorders or somatic disorders; they also were excluded if they engaged in shift work or if they habitually ingested alcohol at bedtime. Sleep logs were observed for all the insomnia participants to exclude circadian rhythm sleep disorders. Twenty-six participants (5%) with other suspected sleep disorders (sleep apnea syndrome or periodic limb movement disorder) underwent n-PSGs for differential diagnosis. In all, 231 insomnia patients (129 women [45.0%]; mean age [standard deviation {SD}], 47.9 years [16.2 years]) met all of the criteria; however, 54 patients were excluded as they did not meet the following criteria: 30 min or longer subjective period of wake after sleep onset or SOL, with frequency of three times or more per week based on quantitative criteria for insomnia [29]; or failure to complete the FIRST-J questionnaire. Consequently 177 insomnia patients (101 women [57.1%]; mean age [SD], 46.8 years [15.8 years] proceeded to subsequent analyses.

From employees of three capital sphere-based companies, 310 healthy participants were recruited. Among them, 205 healthy participants answered the questionnaires (72 women [35.1%]; mean age [SD], 50.8 years [10.1 years]). Inclusion criteria of the healthy participants were less than 30 min of wake after sleep onset or SOL in usual nocturnal sleep [29]. The exclusion criteria were the following: (1) previously or currently diagnosed as having a sleep disorder or psychiatric disease, (2) habitually used hypnotics or bedtime alcohol, (3) engaged in shift work, and (4) failed to complete the FIRST-J questionnaire. Consequently 161 healthy participants (53 women [33.1%]; mean age [SD], 51.5 years [9.5 years]) proceeded to subsequent analyses.

2.2. Procedure and measures

The research questionnaires consisted of the FIRST-J, items related to demographic information, questionnaires assessing subjective severity of insomnia (the Pittsburgh Sleep Quality Index [PSQI] [30,31], the Athens Insomnia Scale [AIS] [32,33]) and a questionnaire to assess trait anxiety (State-Trait Anxiety Inventory [STAI]) [34,35]. Details of these questionnaires are described below.

2.2.1. The FIRST-J

The FIRST is a self-rating score measuring the likelihood of the occurrence of sleep disturbances in response to commonly experienced stressful situations [18]. The questionnaire consists of nine items with evaluation according to a 4-point Likert scale (1, not likely; 4, very likely). Therefore, the total score of the FIRST ranges from 9 to 36. The authors developed the FIRST-J after obtaining permission from the last author of the original version of the FIRST. The original version of the FIRST was translated into Japanese and then back-translated into English. Subsequently, the consistency of the back-translated FIRST-J with the original version was confirmed by the last author of the original version.

2.2.2. The PSQI

The PSQI is a measure to assess subjective sleep disturbance [30,31]. This well-validated questionnaire comprises 19 self-rated items with a 4-point Likert scale (0–3) assessing subjective sleep disturbance during a recent 1-month period. The total score of the PSQI ranges from 0 to 21.

2.2.3. The AIS

The AIS was developed as a measure to assess insomnia severity during a previous 1-month period based on the criteria of the ICD, 10th edition [32,33]. The questionnaire comprises eight items evaluated according to a 4-point Likert scale (0, no problem at all; 3, very severe problem). Therefore, the total score of the AIS is ranges from 0 to 24. The first five items of the AIS correspond to sleep conditions. The last three items cover the next-day consequences of insomnia.

2.2.4. The STAI

The STAI assesses state (actual) and trait (stable) anxiety with 20 questionnaire items, respectively, rated with a 4-point intensity scale (1, almost never; 4, almost always). The total score of the STAI ranges from 20 to 80 [34,35]. Trait anxiety can be regarded as a predisposing factor for insomnia [3,26]; therefore, the items for trait anxiety were used for our study.

2.3. Data analysis

According to the validation process of the original version of the FIRST [18], the following analyses were performed using data of healthy participants. Cronbach α coefficients were calculated to

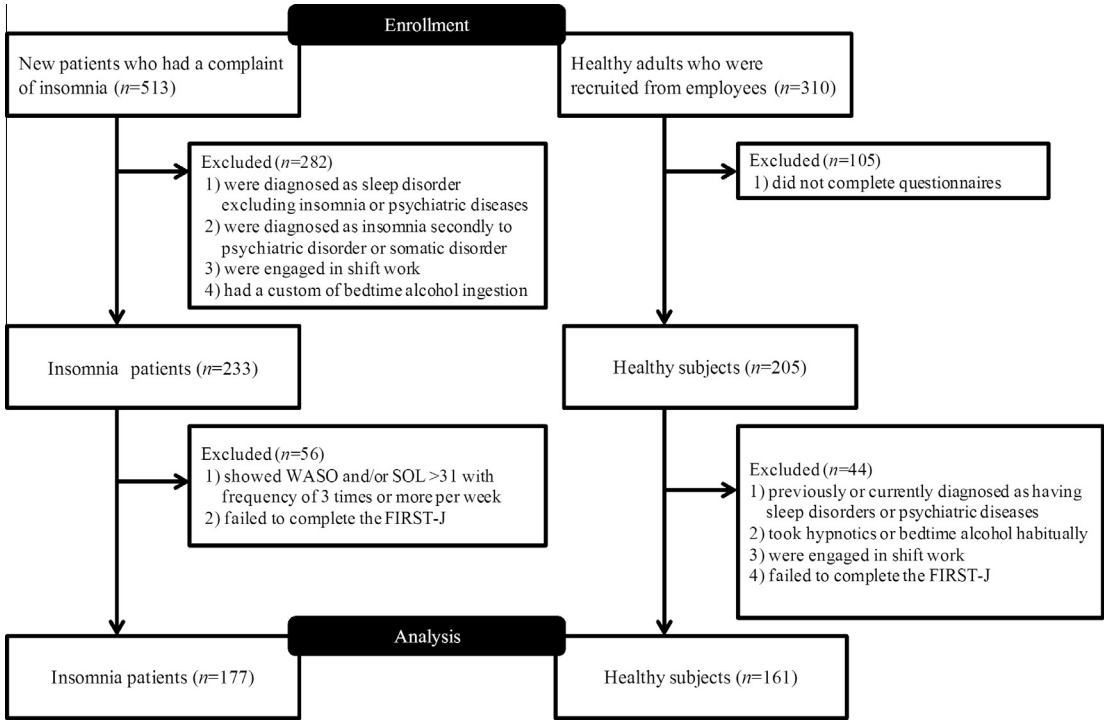

Fig. 1. Participant flow diagram. *Abbreviations:* WASO, wake after sleep onset; SOL, sleep-onset latency; FIRST-J, the Japanese version of the Ford Insomnia Response to Stress Test.

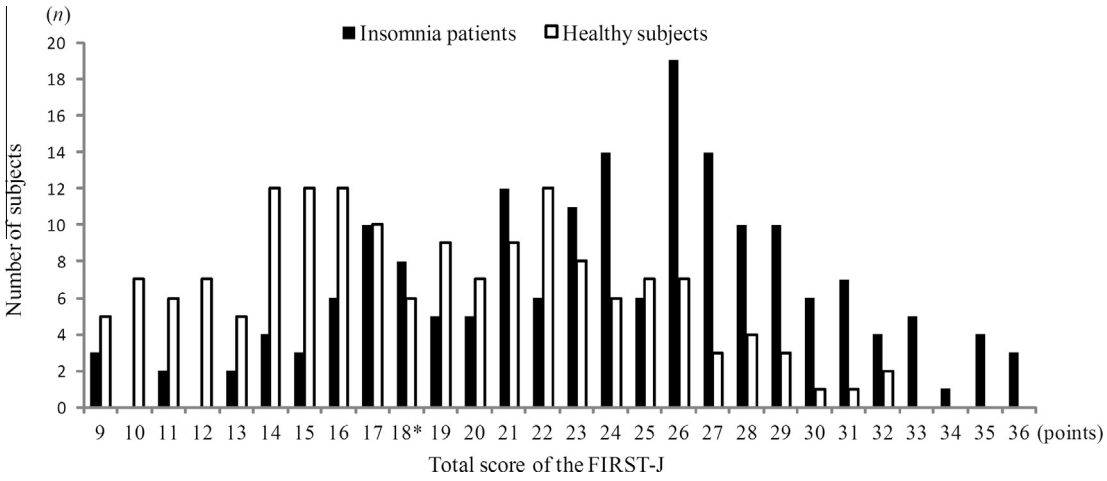

Fig. 2. Distribution of total score of the Japanese version of the Ford Insomnia Response to Stress Test for insomnia patients and healthy subjects. The score of the Japanese version of the Ford Insomnia Response to Stress Test was significantly higher in the insomnia patients than in the healthy subjects ($P < .01$). *Median value in the healthy subjects.

test the internal consistency of the FIRST-J. An exploratory factor analysis using the maximum likelihood method with promax rotation was conducted on the FIRST-J to investigate factorial validity. Before conducting factor analysis, sampling adequacy was verified using the Bartlett spherical test and the Kaiser–Meyer–Olkin measure of sampling adequacy in the groups of insomnia and healthy participants. The Bartlett spherical test is expected to exhibit the propriety of using factor analysis. The Kaiser–Meyer–Olkin values are expected to be greater than 0.70 for making a correlation matrix suitable for factor analysis [36]. Factor loading for the item-inclusion criterion was set at 0.40 according to an earlier study [18]. Severity of insomnia, as evaluated with the PSQI and AIS, was compared among healthy participants and insomnia patients. The measures also were compared among participants with high FIRST-J scores and those with low FIRST-J scores in the respective healthy participants and insomnia patients to test discriminant validity using tests. Because most studies of the FIRST have used the median score of the FIRST in healthy participants to define high and low FIRST groups [18], our also study adopted this standard method.

Additionally, correlation coefficients were calculated among the scores of the FIRST-J, STAI, PSQI, and AIS before and after

controlling for age and gender to identify the association of sleep reactivity with trait anxiety and with severity of insomnia symptoms. Furthermore, the FIRST-J scores of the insomnia patients were compared with those of the healthy participants using tests. Moreover, the quantities of individuals with and without insomnia were compared between the participants with high and low FIRST-J scores in all study populations using χ^2 tests.

In the process explained above, sample sizes differed among respective analyses due to missing data. Data were analyzed using SPSS software version 11.0J (SPSS Inc.), with the significance level set at a 2-tailed α level of 5%. For differences between the two groups, effect sizes were calculated as Cohen [37]. For χ^2 tests, $\varphi(=W)$ was used for estimating the effect size [38]. To clarify the statistical power of the studied samples, post hoc power analyses were performed using G*power 3 [39] on measures representing the difference between the groups: the total score of PSQI for comparison between the groups with insomnia and healthy participants and the FIRST-J score for comparison between the groups with high and low FIRST-J scores.

3. Results

3.1. Reliability (internal consistency)

The internal consistency of the FIRST-J in the insomnia patients and the healthy participants was evaluated using Cronbach α coefficients. Results show that Cronbach α (range of item-deletion α) was 0.89 (0.86–0.88) for the insomnia patients and 0.87 (0.83–0.86) for the healthy participants.

3.2. Factorial validity

From sampling adequacy testing, sphericity in the Bartlett test was significant for the insomnia patients and healthy participants (P<.01). Kaiser–Meyer–Olkin values for the insomnia patients and healthy participants were 0.85 and 0.86, respectively (P<.01). Judging from these results, the following factor analysis was confirmed as appropriate.

The scree plot of the exploratory factor analysis of the healthy participants revealed that the factor structure can be determined as one. After confirming this, exploratory factor analysis was performed with a fixed single factor. The analysis revealed that the FIRST-J has a single-factor structure in which all items showed factor loadings higher than 0.40, except for item 9. A similar result of factor loadings also was observed for insomnia patients. Table 1 presents factor loadings of each item of the FIRST-J for both healthy participants and insomnia patients in our study, referring to the results of the study with the original version of the FIRST on general population [18]. Except for item 9, the factor loadings of each FIRST-J item closely resembled those of the original version. However, we retained item 9 for mutual comparison of the total scores of the original FIRST and our FIRST-J version.

3.3. Discriminant validity

The scores of the FIRST-J and PSQI and AIS were significantly higher in the insomnia patients than in the healthy participants (FIRST-J: $t_{[336]} = 8.35$ [$P < .01$]; PSQI: $t_{[314]} = 30.24$ [$P < .01$]; and AIS: $t_{[335]} = 26.85$ [$P < .01$]). Post hoc power analysis for 2-tailed tests between the insomnia group and the healthy group ($d = 3.42$ [PSQI score], sample size in the healthy adults [score, 161], and sample size in the insomnia group [score, 177]; $\alpha = 0.05$) showed a sufficient power for comparison (1.00). Furthermore, a χ^2 test revealed that the proportion of the insomnia patients was higher in the participants with high FIRST-J scores than in those with low FIRST-J scores ($\chi^2_{[1338]} = 19.81$; $P < .01$; $\varphi = -0.24$ [95% confidence interval {CI}, −0.14 to −0.34]).

The median value of the total score of the FIRST-J in the healthy participants was 18 (Fig. 2). The healthy participants with high FIRST-J scores (FIRST-J score >18) comprised 41 men (51.9%) and 38 women (48.1%), with a mean (SD) age of 49.7 (10.2) years. The healthy participants with low FIRST-J scores (FIRST-J score ⩽18) comprised 67 men (81.7%) and 15 women (18.3%) with mean age of 53.2 (8.4) years. The insomnia patients with a high FIRST-J score (FIRST-J score >18) comprised 57 men (40.7%) and 83 women (59.3%) with mean (SD) age of 47.0 (15.5) years. The insomnia patients with low FIRST-J scores (FIRST-J score ⩽18) comprised 19 men (51.4%) and 18 women (48.6%) with a mean (SD) age of 46.1 (16.8) years. Table 2 presents scores of each measure for all participants with low and high FIRST-J scores.

Comparison of the scores of measures between the healthy participants with low FIRST-J scores and those with high FIRST-J scores revealed that all the scores were significantly higher in the latter group than in the former group (PSQI: $t_{[149]} = -2.12$ [$P = .04$]; AIS: $t_{[159]} = -3.16$ [$P < .01$]; and STAI: $t_{[153]} = -4.23$). Post hoc power analysis for 2-tailed tests between the high-scoring FIRST-J group and the low-scoring FIRST-J group ($d = 3.20$ [FIRST score], sample size in the high-FIRST-J group [score, 79], sample size in the low-FIRST-J group [score, 82], $\alpha = 0.05$) showed sufficient power for comparison (1.00). The healthy participants with high FIRST-J scores were younger and showed a higher proportion of women than those with low FIRST-J scores (age, $t_{[159]} = -19.98$ [$P < .01$]; gender, $\chi^2_{[1161]} = 16.19$ [$P < .01$]).

In the insomnia patients, significant difference was only found in the STAI between the high-scoring FIRST-J group and the low-scoring FIRST-J group ($t_{[129]} = -2.96$ [$P < .01$]). Post hoc power analysis for the 2-tailed test between the high-scoring FIRST-J group and the low-scoring FIRST-J group ($d = 2.78$ [FIRST score], sample size in the high-scoring FIRST-J group [score, 129], sample size in group with low-scoring FIRST-J group [score, 36]; $\alpha = 0.05$) showed sufficient power for comparison (1.00).

3.4. Association of the FIRST-J with the STAI, PSQI and AIS

Table 3 presents correlation coefficients among the scores of the FIRST-J, STAI, PSQI, and AIS in the insomnia patients and healthy participants. In the healthy participants, the FIRST-J score showed significant but weak positive correlations with the scores of all other measures ($P < .01$). However, the FIRST-J correlated neither with the PSQI nor with the AIS in the insomnia patients, it but showed moderate correlation with the STAI ($P < .01$). Additionally, we conducted partial correlation analysis after controlling for age and gender. Consequently, the correlation coefficients between the FIRST-J and each of the PSQI (i.e., the AIS and the STAI) were similar to those before controlling for these factors either in the insomnia patients or in the healthy participants.

To clarify the effect of item 9 on the relation between the FIRST-J and the PSQI, AIS, or STAI, correlation analyses were conducted again using the total score of the FIRST-J after excluding the score of item 9. The result showed that correlation coefficients between the FIRST-J without item 9 and the other three measures were similar to those between the FIRST-J with the score of item 9 and the others.

4. Discussion

The main purposes of our study were to investigate the validity of the FIRST-J and to clarify the association of FIRST-J with trait anxiety and severity of insomnia symptoms in the insomnia patients and healthy participants. Consistent with the results of the

Table 1
The factor loadings in exploratory factor analysis of the Japanese version of the Ford Insomnia Response to Stress Test among the healthy subjects, the insomnia patients, and the previous results of the participants in the study with the original version of the Ford Insomnia Response to Stress Test.

Items	Healthy subjects (n = 161)	Insomnia patients (n = 177)	Drake et al. [18] (n = 104)[a]
3. After a stressful experience in the evening	0.92	0.85	0.73
2. After a stressful experience during the day	0.89	0.85	0.40
4. After getting bad news during the day	0.76	0.77	0.73
6. After having a bad day at work	0.74	0.70	0.68
7. After an argument	0.68	0.69	0.76
1. Before an important meeting the next day	0.63	0.51	0.56
8. Before having to speak in public	0.58	0.48	0.42
5. After watching a frightening movie or television show	0.48	0.40	0.48
9. Before going on vacation the next day	0.22	0.21	0.51

[a] Participants were from a general population-based sample other than individuals with notable sleep-disordered breathing. Instructions of the Ford Insomnia Response to Stress Test were as follows: "When you experience the following situations, how likely is it for you to have difficulty sleeping? Circle an answer even if you have not experienced these situations recently."

Table 2
Comparison of variables between the subjects with low scores and high scores on the Japanese version of the Ford Insomnia Response to Stress Test.

Subjects and variables	Total subjects	Subjects with low scores on the FIRST-J	Subjects with high scores on the FIRST-J	P value (low FIRST-J vs high FIRST-J)	Effect size (95% CI)	
Healthy subjects						
Demographics						
Age (y)	51.5 ± 9.4	53.2 ± 8.4	49.7 ± 10.2	<.05[a]	d = 0.38	(0.07–0.69)
Gender (women, %)	32.9	18.3	48.1	<.01[b]	φ = 0.31	(0.16–0.45)
Measures						
FIRST	18.6 ± 5.6	14.0 ± 2.6	23.5 ± 3.3	<.01[a]	d = 3.20	(2.74–3.66)
PSQI	4.3 ± 2.2	3.9 ± 2.2	4.7 ± 2.1	<.05[b]	d = 0.47	(0.02–0.66)
AIS	2.9 ± 2.1	2.4 ± 1.9	3.4 ± 2.1	<.01[a]	d = 0.50	(0.19–0.81)
STAI	41.6 ± 10.4	38.2 ± 9.5	44.9 ± 10.3	<.01[a]	d = 0.68	(0.36–1.00)
Insomnia patients						
Demographics						
Age (y)	46.8 ± 15.8	46.0 ± 16.9	47.0 ± 15.5	ns[a]	d = 0.06	(−0.43 to 0.30)
Gender (women, %)	57.1	52.2	62.1	ns[b]	φ = 0.09	(−0.06 to 0.23)
Measures						
FIRST	24.0 ± 5.9	15.4 ± 2.7	26.3 ± 4.2	<.01[a]	d = 2.78	(2.21–3.36)
PSQI	13.0 ± 2.8	13.1 ± 3.0	12.9 ± 2.8	ns[a]	d = 0.07	(−0.36 to 0.50)
AIS	12.4 ± 2.8	12.7 ± 4.5	12.3 ± 3.8	ns[a]	d = 0.10	(−0.48 to 0.68)
STAI	48.2 ± 10.48	43.1 ± 9.4	49.6 ± 10.8	<.01[a]	d = 0.62	(0.20–1.03)

Abbreviations: FIRST-J, Japanese version of the Ford Insomnia Response to Stress Test; CI, confidence interval; y, years; PSQI, Pittsburgh Sleep Quality Index; AIS, Athens Insomnia Scale; STAI, State-Trait Anxiety Inventory (items for trait); ns, not significant.

[a] Unpaired test.

[b] χ^2 test, ranges of sample size depending on the number of missing data are the following: 155–161 in the healthy subjects, 131–176 in the insomnia patients, 76–82 in the healthy subjects with low scores on the FIRST-J, 72–79 in the healthy subjects with high scores on the FIRST-J, 29–37 in the insomnia patients with low scores on the FIRST-J, and 102–140 in the insomnia patients with high scores on the FIRST-J.

original version, the FIRST-J was confirmed to have adequate internal consistency with a high Cronbach α coefficient among the study population. Exploratory factor analysis also revealed that the FIRST-J had a single-factor structure closely resembling that of the original version, though the factor loading of item 9 (before going on vacation next day) was lower than the value of the original version. However, considering the lack of influence of item 9 on correlations between the FIRST-J and the measures for insomnia severity or anxiety, we believe that removal of item 9 is not necessary for comparison of the total score of the FIRST between the original version and the Japanese version. Although the reason for the low factor loading of item 9 remains unclear, this difference could possibly be due to cultural or racial differences between participants in Japan and in the United States, where the original version of the FIRST was developed. This speculation is supported by the fact that the influence of a positive emotion-related stressor such as a vacation is likely to be reflected by cultural or racial differences [40,41].

Two cognitive processes, rumination after experiencing a particular stressor and worry before experiencing a particular stressor, reportedly influenced the insomnia mechanism [42]. Our study revealed that the influence of the former was stronger than that of the latter: items in the FIRST-J associated with rumination (items 2, 3, 4, 5, and 7) showed higher factor loadings than those associated with worry (items 1, 8, and 9), which is consistent with the report by Carney et al. [42]. However, factor analysis showed no 2-factor structure. Rumination- and worry-associated items were clearly distinguishable. In our study, the scores of the PSQI and AIS for the healthy participants with high FIRST-J scores were significantly higher than those for participants with low FIRST-J scores, which is consistent with the results of the original version using n-PSG measures [18]. This finding indicates that the FIRST-J has adequate discriminant validity.

Our results of the FIRST-J score positively correlating with the score of the STAI in both the healthy participants and the insomnia patients indicate that sleep reactivity is related with trait anxiety, which is known as a factor determining vulnerability to insomnia [3,26]. Correlation also was found between the score of the FIRST-J and those of the PSQI or the AIS in the healthy participants. However, no significant correlation was found between the FIRST-J and these measures in the insomnia patients, which might indicate that sleep reactivity is related with vulnerability to insomnia, but it does not play a major role as a process aggravating insomnia. Among the healthy participants, significant differences were found

Table 3
Correlations between scores of the Japanese version of the Ford Insomnia Response to Stress Test and the other measures in the healthy subjects and the insomnia patients.

			STAI	PSQI	AIS
Healthy subjects[a]	Not adjusted	FIRST-J	.44**	.22**	.30**
		FIRST-J without item 9	.44**	.23**	.29**
	After controlling for age and gender	FIRST-J	.47**	.20*	.26**
		FIRST-J without item 9	.47**	.21*	.23**
Insomnia patients[b]	Not adjusted	FIRST-J	.39**	.03	.05
		FIRST-J without item 9	.39**	.02	.07
	After controlling for age and gender	FIRST-J	.45**	.04	.06
		FIRST-J without item 9	.43**	.04	.07

Abbreviations: FIRST-J, Japanese version of Ford Insomnia Response to Stress Test; STAI, State-Trait Anxiety Inventory (items for trait); PSQI, Pittsburgh Sleep Quality Index; AIS, Athens Insomnia Scale.
Parentheses indicate 95% confidence interval.
[a] Sample sizes range from 131 to 172 depending on the number of missing data.
[b] Sample sizes range from 151 to 161 depending on the number of missing data.
** $P < .01$.
* $P < .01$.

in age and gender between the groups with high and low FIRST-J scores. However, no significant differences were found in these variables between the groups with high and low FIRST-J scores in the insomnia patients. Regarding gender differences, our result was consistent with a report of a previous study described by Drake et al. [18]. The higher rate of women in the high-scoring FIRST-J group might be one factor for the predominant female prevalence of insomnia. Regarding age, Drake et al. [18] reported that high-scoring FIRST participants were older than those who were low scoring, though the healthy participants with high FIRST-J scores were younger than those with low scores in our study. The reason for this inconsistency is unclear. However, neither age nor gender had a notable influence on correlation between sleep reactivity and insomnia severity or anxiety.

As also shown in results of an earlier study [27], our study revealed that the insomnia patients had a significantly higher FIRST-J score than the healthy participants. The participants with high FIRST-J scores also included a greater number of participants with insomnia. These results support the idea that sleep reactivity is associated with vulnerability to insomnia.

Our study has some limitations. First, only self-rating scales were used for evaluating insomnia. Further study should be conducted using n-PSG measures, not only for screening other sleep disorders but also for drawing conclusions about the relation between sleep reactivity and insomnia. Second, no assessment of stress manipulation was performed in our study. An earlier study [21] showed that participants with high FIRST-J scores were more likely to feel daily stress that negatively affected their sleep, and thus further study should be undertaken to explore the relation between sleep reactivity and stress manipulation. Third, the test–retest reliability of the FIRST-J was not validated in our study. Fourth, our study was conducted with a cross-sectional design. Prospective research should be made to clarify the significance of sleep reactivity on the development of insomnia. Fifth, current participants with insomnia might not be representative of the general insomnia population, as they were recruited from outpatients of a single sleep disorders clinic.

5. Conclusion

The FIRST-J has satisfactory validity and internal consistency similar to the original version. Considering that FIRST-J was associated with severity of insomnia in the healthy participants but not in the insomnia patients, the measure is expected to become an important trait marker for insomnia in Japanese individuals.

Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: http://dx.doi.org/10.1016/j.sleep.2013.09.022.

Acknowledgments

Our study was supported by a Grant-in-Aid for Young Scientists (B) (22730574) from the Japan Society for the Promotion of Science.

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